

**State of
CCSP/EOS/CERES/NPP/NPOESS/NRC
Decadal Study/A-train/ASIC³**

B. Wielicki

**8th CERES-II Science Team Meeting
November 14-16, 2007
Victoria, British Columbia**



Langley Research Center / Atmospheric Sciences Division



Keeping our eye on the ball...



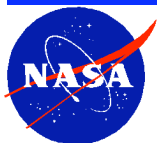
U. S. Climate Change Science Plan (CCSP)

- CCSP Observation Working Group (OWG) held a June 14/15 retreat on climate observation requirements.
 - Short term plan is based on community assessment of impact vs feasibility similar to ocean observing system approach.
 - Long term approach is climate model based climate OSSEs
- ASIC³ Multi-agency workshop on ways to achieve satellite climate calibration goals held May 16-18, 2006 in DC. Follow-on to Ohring et al., BAMS Sept 2005. Workshop report now in second draft form: expect release in next few months.
- NRC review of CCSP underway: preliminary indications are good science, but poorly funded and space-borne climate observing system is collapsing (e.g. NPOESS climate inst)



IPCC Assessment Report 4

- Cloud feedback remains the largest uncertainty in climate sensitivity and low clouds dominate the uncertainty. Feedback that changes planetary albedo.
- Aerosol indirect effect remains largest uncertainty in anthropogenic radiative forcing (changing albedo).
- Decadal changes in cloud/radiation now included in Chapter 3, including ocean heat storage/net radiation consistency.
- Expanded discussion of climate prediction uncertainties including early perturbed physics ensembles.
- Low and High sensitivity climate models show similar global mean temperature increases next several decades: large separations after 2050. Implies we need methods to resolve cloud feedback well before then to constrain climate sensitivity.
- Forcing $0.6 \text{ Wm}^{-2}/\text{decade}$: 25% cloud feedback $0.15 \text{ Wm}^{-2}/\text{decade}$ in cloud radiative forcing: *0.3%/decade in SW channel gain.*



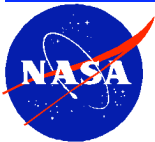
NASA Earth Science

- NASA Administrator is Michael Griffin
 - New AA for Space and Earth Science is Alan Stern
 - Head of Earth Science is Mike Freilich
 - Deputy for Earth Science is Bryant Cramer
 - Don Anderson is Modeling lead and CERES Program scientist
 - Hal Maring is Radiation Sciences program lead
 - NRC Earth Science Decadal Study released Jan 2007. NASA committed to follow this overall guidance.
- FY08 and beyond budgets remain unclear
 - FY09 "passback" from OMB to NASA thanksgiving
 - FY08 budget: congress trying to increase earth science to solve climate/NPOESS issues and start decadal study missions, but Bush threatens to veto.

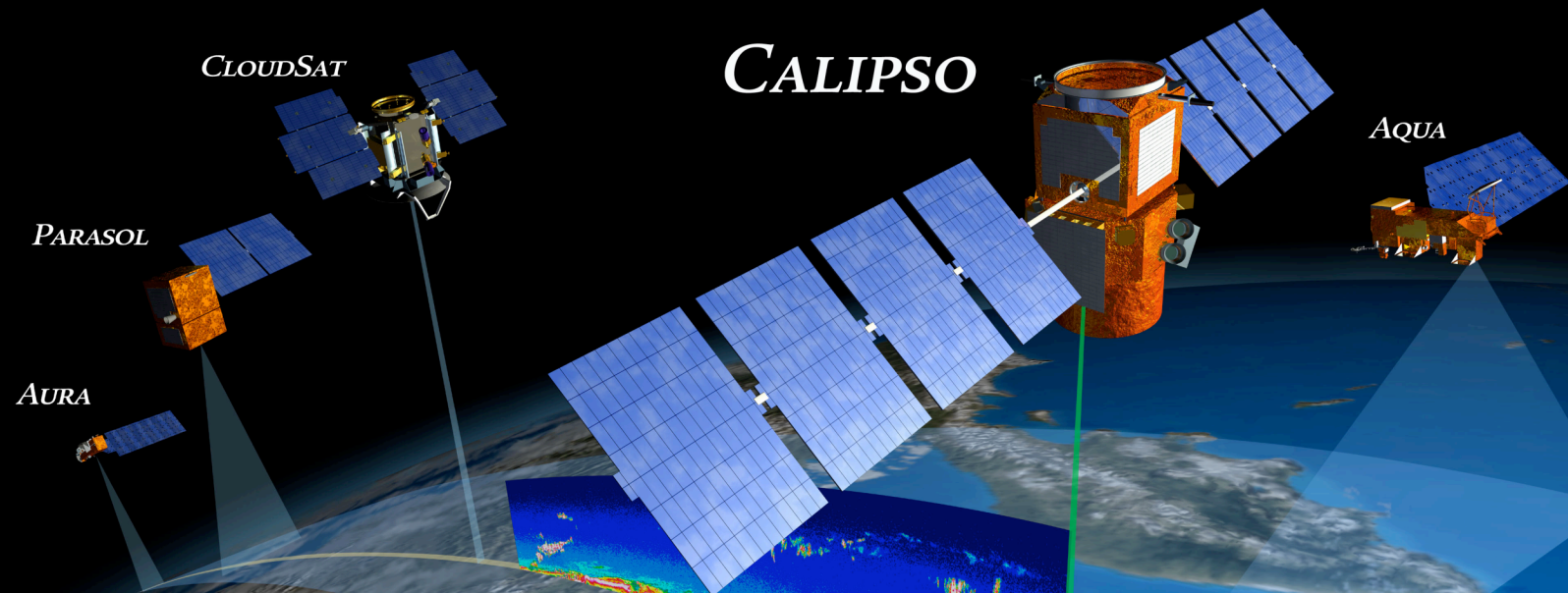


CERES Program

- Terra and Aqua Senior Review (spring/summer 2007) went very well
 - Norm Loeb led CERES input to the Terra and Aqua team proposals
 - NASA HQ fixed the 10% funding shortfall in FY07
 - NASA HQ agreed to fully fund Terra/Aqua baseline request for FY08/09
 - NASA HQ did not fund the "enhanced" budget request.
 - CERES has 450 journal papers with 5500 citations through 2006
 - Distributed to users over 20Tbytes of data in 2005, 60Tbytes in 2006
- NASA Energy and Water System (NEWS) science group
 - global water and energy data sets, including A-train: subsets of CERES, MODIS, CALIPSO, Cloudsat along the lidar/radar ground track (64km swath). Seiji Kato leading merged product development



A-train is on track...



CALIPSO

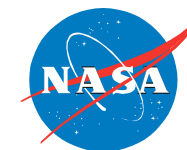
Probing Earth's atmosphere to unravel the
mysteries of climate change.



Future: CERES, NPP and NPOESS

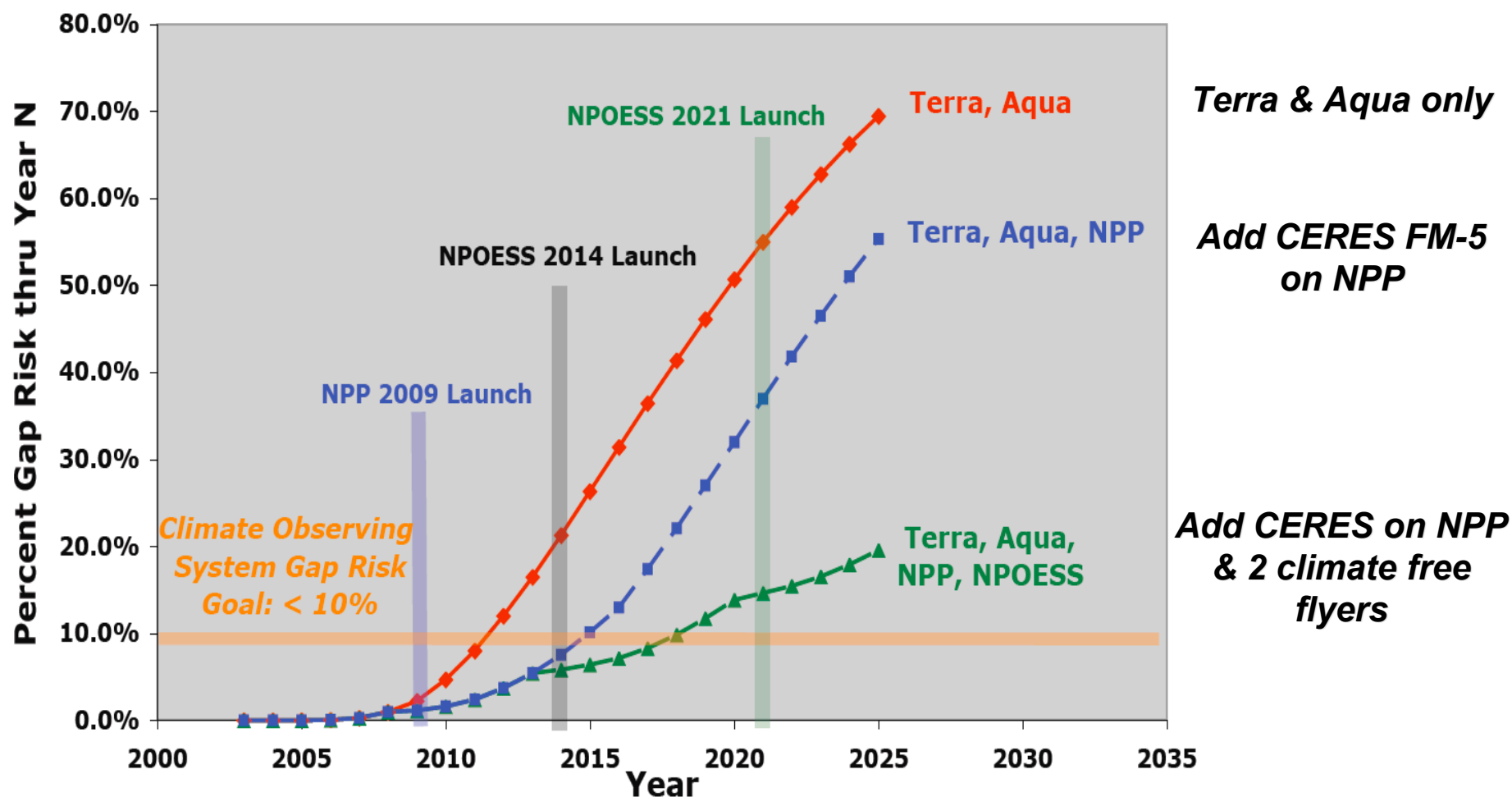
- NPOESS had planned CERES FM-5 instrument on first NPOESS 1:30 orbit launch in 2010, and then ERBS copies in 2015 and beyond.
- NPOESS seriously over budget and behind schedule: triggered Nunn-McCurdy review in U.S. congress completed June 2006.
 - Major problems with VIIRS imager, CMIS microwave imager/sounder
 - Dropped all climate instruments: radiation budget, solar constant, altimeter, etc.
 - Dropped CMIS, VIIRS challenges remain: cooler and optical crosstalk.
 - Then CrIS interferometer broke its frame in vibration testing
 - Not clear if NPOESS will be able to meet any climate requirements given budget/schedule problems, and given weather data is critical priority (not climate)
 - NPOESS still proposes to fly CERES FM-5 last copy on C1 platform, but now delayed to ~ 2014.
 - Gap risk now exceeds 10% climate goal (BAMS 2005, Ohring et al).
 - Discussions with engineering staff indicate failure rates per year are relatively constant up to about 5 years, then increase over time.
 - Gap risk to 2014 too large: recommend moving CERES FM-5 to NPP mission for launch in 2010 with VIIRS(MODIS-like imager) and CrIS (interferometer).





What is the Radiation Budget Gap Risk?

3 future scenarios: NPP and Climate Free-flyers



Gaps start the climate data record back at zero.

NPP and NPOESS

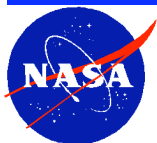
- Given concern on losing climate instruments, the U.S. Office Science and Technology Programs (OSTP) requested NASA and NOAA to produce a white paper on how to deal with the NPOESS climate instrument deletion
- Joint NASA/NOAA white paper submitted to OSTP Jan 2007: recommended moving CERES FM-5 up to flight on NPP mission in 2010, build of copies to add to NPOESS platforms in 2014 and 2019. Fly with VIIRS imager for CERES-like data products
- Other recommendations included elimination of likely gaps in solar constant, altimetry for sea-level, ozone vertical profiles...
- NOAA and NASA budgets do not currently include this funding. Congress is trying to put it in the FY08 budget (~\$25M for FY08) but any increases threaten veto by Bush.
- Feasibility studies of CERES on NPP for spacecraft, instrument, & ground data system modifications were completed over the last year (LaRC, GSFC, Ball, NGST)
 - CERES contributions led by Kory Priestley and Jim Miller. GSFC NPP mission lead.
 - No technical problems, risk low since NPP spacecraft original design included CERES.
 - Could meet late 2009 NPP launch date if start in November 2007.
 - Could meet later launch date with a month/month slip if keep key NGST staff funded.
 - Still uncertainty on NPP scheduled late 2009 launch: continued VIIRS problems, and recent vibration test major failure on CrIS. More likely launch in mid-2010, but remains uncertain.
 - Studies also have been done on CERES-II builds, fly on NPOESS or in formation with NPOESS. Use lessons learned on CERES to further improve ground and in-orbit calibration. NPOESS C1 launch 2013/2014.



NASA/NOAA/NPOESS

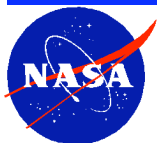
NPP decision meeting at NASA HQ Nov 4

- GSFC NPP project presented CERES FM-5 on NPP cost/risk/schedule
 - Total cost \$60M over 8 years but most in the first 2 years before launch.
- Stern questioned the analysis of a gap risk and wanted a "non-advocate" separate data gap analysis.
 - Stern thinks Terra and Aqua CERES will last 20 years
 - Henning Leidecker at GSFC conducting the analysis
 - Early reports from Henning is that our analysis underestimates the risk of a gap because risk/yr of failure after 5 years rises. Final in a week or two.
- Stern questioned the science impact of a gap: why couldn't we just "splice" across a gap? Requested a gap impact analysis
 - Norm Loeb led this analysis
 - Climate sensitivity => cloud feedback = cloud radiative forcing for requirement
 - CERES Terra data to define natural variability (takes 20yrs global S/N 90% conf)
 - Simulate 30 year records and Monte Carlo gap effect
 - A) CERES data only across the gap; B) Imager plus theory across the gap
 - Answer: for either CERES alone or CERES/Imager cannot allow even 1 month gap or for decadal change signal you restart the record from zero.



NASA/NOAA/NPOESS NPP decision meeting at NASA HQ Nov 4

- NOAA backed out of funding CERES FM-5 on NPP (had been recommended by NRC Decadal Survey): insufficient funds
- Stern was concerned about further delays in putting CERES on NPP
 - NPP "marching army" cost is \$5M/month for launch delays
 - VIIRS has a critical test of its cooler in Feb 2008: GSFC engineers predict that it is likely to fail testing, requiring a further 1 year delay in VIIRS
 - Nominal NPP launch remains Sept 2009. No one believes it.
- Stern directed the non-advocate gap analysis and gap impact studies to be done as soon as possible.
- Stern directed that studies of putting CERES FM-5 on a smallsat flying in formation with NPP be done to look at other options
 - Pegasus type smallsat: \$250M cost
 - Minotaur V (unflown) with unflown microsat: \$150M but < 2yr lifetime and little reduction in gap risk as "Class D" mission with low reliability.
- Expect early December for next meeting for CERES FM-5 on NPP or smallsat.



NRC Decadal Survey

- Released Feb 2007
- NASA committed to support, missions "notional"
- CLARREO one of 4 first missions with earliest action
 - NOAA pay to eliminate gaps in CERES and TSIS (NPOESS loss)
 - New Benchmark IR and Solar Spectral climate record
 - IR: 0.1K 95% confidence absolute calibration, 100km fov, 1cm^{-1} , 3 - 50 μm
 - IR: 2 satellites 90 precessing inclination for diurnal cycle
 - Solar: 0.2% 95% conf. absolute calibration, 100km fov, 10nm, 0.3 - 3 μm
 - Solar: 1 orbit 90 precessing inclination
 - IR/Solar: ability to calibrate other instruments in orbit to climate accuracy
 - IR/Solar: Nadir only, small instruments, smallsats, \$200M total.
- NRC asked to do "Delta" study on loss of NPOESS climate instruments
 - Recommended adding CERES FM-5 to NPP and building next generation copies to fly in formation with NPOESS VIIRS 2014/2020.



NRC Decadal Survey

- CLARREO Workshop held July 2007,
 - workshop summary produced: definition studies needed
 - Great opportunity to raise weather/research observations to decadal climate change accuracy, reduce costs/sensitivity to data gaps.
- Dave Young and LaRC asked by NASA HQ to develop plan for pre-phase A studies with workshop participants
 - Study plan presented to D. Anderson/Bryant Cramer Nov 8th at LaRC.
 - Key modeling studies of spectral benchmarks/climate prediction
 - Key data studies of CLARREO calibration of other instruments
 - Key data studies simulating CLARREO spectral benchmark
 - International collaboration: TRUTHS (Nigel Fox): Solar part of CLARREO?
 - Continuous open community participation
 - Produce shortened pre-phase A study plan for Freilich/Stern
 - NASA passback budget thanksgiving will set course for slow or faster action on CLARREO and other decadal survey mission studies

